

BALLYCOTTIN PIER.

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RETURN to an Order of the Honourable The House of Commons,  
dated 8 March 1889;—for,

COPY "of REPORT on the PIER at BALLYCOTTIN, County CORK, by  
Mr. John Wolfe Barry, M.I.C.E., dated the 21st day of December  
1888."

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Treasury Chambers, }  
8 March 1889.

W. L. JACKSON.

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(*Mr. Jackson.*)

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*Ordered, by The House of Commons, to be Printed,*  
8 March 1889

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COPY of REPORT on the PIER at BALLYCOTTIN, County CORK, by  
Mr. John Wolfe Barry, M.L.C.E., dated the 21st day of December  
1888.

To the Lords Commissioners of Her Majesty's Treasury.

23, Delahay-street, Westminster, S.W.,  
21 December 1888.

My Lords,

I HAVE the honour to report my opinion on the construction and condition of the pier at Ballycotton, county Cork, as requested in Mr. Frank Mowatt's letter (15,621—88).

I visited the pier on the 6th October last in company with Mr. Jackson, and met several members of the Grand Jury, who were attended by their surveyor, Mr. Kirkby. The following also attended, viz.: Rev. M. P. Norris, c.c., and Dr. Tanner, m.p., representing the local interests; Mr. Manning and Mr. Kenting on the part of the Board of Works; Mr. Martin, the contractor for the pier; the diver who was employed by him; the officers of the Coast-guard; fishermen, and others.

My inspection was made at low water of an unusually low spring tide, and the sea was sufficiently calm to permit of my examining the outer face of the pier from a boat.

During my visit I gave instructions for careful levels and measurements to be taken on the pier, and for a series of soundings to be made in the harbour. All these observations, which occupied some considerable time, were executed for me by my assistant, Mr. Gifford, who accompanied me from England.

The pier (see Fig. 1), which is an extension of a pier erected in 1847, encloses, with the northern breakwater (as to which no questions have arisen), an area of 4 a. 0 r. 14 p. at high water, and 2 a. 2 r. 24 p. at low water of spring tides. The depth of water at the pier head is 13 feet at low water of ordinary spring tides, and the areas enclosed by the pier and breakwater with the depths of water at low water of ordinary spring tides, are as follows:—

						a.	r.	p.
12 feet line of sounding	-	-	-	-	-	0	0	37
10 "	"	"	"	-	-	0	2	11
5 "	"	"	"	-	-	1	1	23

The total length of the new pier from its junction with the angle of the old pier is about 340 feet, of which length about 180 feet from the old pier are founded upon rock, the remainder or outer portion being on sand.

The new pier is constructed with two parallel longitudinal walls which are 41 feet apart from outside to outside, and are connected at about every 40 feet by cross walls.

The pier head, which is formed by a bend 25 feet long at right angles to the course of the main body of the pier, is 35 feet wide, and its construction is similar to that of the main portion of the pier.

The mode of constructing the outer and inner walls of the pier, as contemplated under the contract, was that the foundation up to the level of low water should consist of blocks of Portland cement concrete weighing about five tons each placed in position by divers. Above low water the upper part of the walls was to be constructed of Portland cement concrete mixed and moulded *in situ*. Where the concrete blocks were to rest on rock the rock was to be levelled to make a bed for the blocks, and where they were on a sandy bottom the sand was to be excavated to depths varying from two to three feet.

After

After the contract was let the contractor offered without extra charge to construct the foundations with blocks weighing from 24 to 53 tons in the outer wall, and from 12 to 55 tons in the inner wall, and his offer, which was an advantageous one for Government, was accepted. As a result of this increase of size two tiers of blocks in height have been, even in the deepest part of the pier, sufficient to raise the foundations above the level of low water of spring tides, above which level the intended mode of constructing the walls of concrete mixed *in situ* has been carried out. (See Figs. 2 and 3.)

The large concrete blocks are connected together by two vertical dowels passing from top to bottom of each block; one of these dowels is about two feet and the other eight feet from the outside face of the wall.

The outer wall is finished with a parapet of Portland cement concrete made *in situ* about eight feet high in two steps respectively,  $6\frac{1}{2}$  feet and  $3\frac{1}{2}$  feet thick.

The space between the walls is filled with rubble hearting which for a width of six feet behind the walls above low-water mark was packed by hand, the remainder being merely deposited in place from carts.

The bottom of the cross walls connecting the longitudinal walls is not carried to the full depth of the outer and inner walls, but is 12 feet above their foundations. The cross walls thus rest on about 10 feet of rubble.

On the top of the rubble and over the top of the cross walls a layer of concrete has been laid across the whole width of the pier, and on this for a width of 23 feet next to the harbour heavy stone paving rests. A bed of fine concrete paving has been laid next to the parapet on the remaining 12 feet of the width of the pier.

After a careful inspection of the pier and harbour, I held an inquiry as to the points at issue and received evidence in detail.

The complaints of the county surveyor to the Grand Jury as to construction were stated in answer to my inquiries to be:—

(1.) That the pier showed distinct signs of settlement at the pier head, which might become more serious.

(2.) That some of the dowels between the concrete blocks had been omitted, and that as a consequence of this omission the sea freely entered into the hearting and could wash away any small and dirty particles in the filling.

(3.) That the filling between the walls consisted not of rubble, as described in the contract, but of a considerable quantity of dirt.

(4.) That the foundations of the portion of the old pier which projected into the harbour had not been properly removed, and consequently that there is sudden shoaling at this spot, which is dangerous to vessels using the harbour, and is contrary to what was promised.

All these objections were endorsed by the Rev. M. P. Norris on behalf of the local fishermen, and the following complaints as to other faults of construction were advanced, viz.:

(5.) That a considerable number of cracks had appeared in the upper part of the wall where the concrete was made *in situ*.

(6.) That several cracks had appeared in the paving and that the paving had sunk in several places, so that water falling on the pier would not drain away.

(7.) That in other places the hearting had subsided, and the paving had remained in position unsupported by the hearting.

It will be best to consider the above objections *seriatim*, and in doing so it is desirable to draw attention to the fact that, except with regard to certain cracks in the pier head, the county surveyor declined to endorse the complaints raised by the local representatives in Objection 5 as to the cracks which have appeared in the concrete made *in situ*. He considered that such cracks did not in themselves indicate any movement of the wall, and that they were probably due to the contraction of the material, which very often takes place in great lengths of concrete made in one piece. He also did not

lay any stress on the inequalities or cracks in the paving except so far as they were evidence, in his opinion, of the heaving being affected by the sea.

The cracks at the pier head, to which my attention had been specially drawn, are no doubt in a different category from those in the main longitudinal walls, and the county surveyor considered them of importance, holding that they are due to some continued settlement of the foundations.

I agree with the county surveyor in thinking that there are distinct signs of settlement at the pier head and that the other cracks are immaterial, being due to the reason above suggested.

I will, therefore, proceed to refer in detail to the condition of the pier head.

The space originally left between the concrete blocks beneath the pier head at the north-west corner became wider after the pier was nearly finished, and the space has been filled with small bags of fine cement concrete. A crack of considerable size appeared in 1886 or 1887 above the blocks in question and extended upwards to the coping. Its position is shown on Fig. 2.

The crack which was then  $1\frac{1}{2}$  inches wide at the coping level was pointed with cement about October 1887, when it was supposed that the movement of the foundations had ceased. It required to be pointed again in May 1888, and I was informed by the county surveyor that the amount of movement had then reached a width of about four inches, though I scarcely think that it could have been so much. At that time concrete in bags was inserted in the crack, and the surface of the face of the pier head on both sides of the crack was repaired with fine cement concrete and rendered.

At the time of my visit it was evident that some slight movement had taken place since the pointing in May 1888. The crack had re-opened so that there was an open joint in the coping one-sixteenth of an inch wide, and the coping was slightly out of line. The cement rendering on the face of the pier was loose and on being struck was easily detached.

In addition to the information respecting the pointing of this crack we have some evidence deduced from a comparison of measurements taken by Mr. Keating, the resident engineer, in January 1887, with measurements taken by my assistant in October of this year. These show that the west face of the pier head has, at the north-west angle, gone over  $2\frac{1}{2}$  inches to the westward since Mr. Keating's measurements were taken, and that at the south-west angle the movement has amounted to  $1\frac{1}{2}$  inches in the same direction. In addition to the crack on the north face of the pier head, there is a small crack on the west face which may be caused by the greater movement of the north-west angle as compared with the south-west angle.

I understand from the diver employed by the contractor that the sand on which the concrete blocks rest at the pier head is softer than elsewhere, and that in rough weather he found that the bottom was easily disturbed by the action of the waves.

All the above evidence decidedly supports the theory of a subsidence of the concrete blocks, which form the foundation of the end of the pier head, and in my opinion the history of the crack on the north face cannot be explained in any other way.

The cracks are very near the end of the pier, and there is a danger that if the settlement continues, or if the crack remains open, the shock of waves acting on air or water in the crack may exercise such a force as may split off a portion of the end of the pier.

The questions thus arise, whether the settlement will continue, and what steps should be taken in view of the weakness exhibited at this particular part of the structure.

Considerable quantities of large rubble have been placed, as was always intended should be the case, not only outside the pier head, but also wherever the pier is founded on sand, the object of which is to prevent any disturbance of the sand by the action of the sea. The rubble, however, has been in its place for a long time, and as the settlement at the pier head has undoubtedly been in progress since the deposition of the rubble and cannot be said at present to have ceased, it is clear that the rubble alone cannot be relied on as a remedy.

It is possible, and even probable, that the settlement may not proceed much further than at present, but this again cannot be relied on with any certainty.

It is impossible also, now that the end of the pier is cracked, to restore by any pointing of the concrete the original condition of the unbroken structure, and even if no further subsidence takes place, it is more than probable that the pointing of the cracks will become loose from the shock of waves. I may remark that I have never known an instance where the pointing of a crack in a wall exposed to vibration, has remained for long unbroken.

I think, therefore, that the pier-head should be strengthened, and that the readiest way of so doing is to surround the head with stout galvanized iron bands, carried back to and connected with the main portion of the pier, so as to firmly unite the two portions of the pier-head. The bands, though galvanized, would after a time suffer from corrosion, but they would last many years if painted after the zinc coating had worn off, and they could be easily and inexpensively replaced when necessary.

(2.) With regard to the second point that was raised, viz., that some of the dowels between the concrete blocks had not been inserted, I find after careful examination that in six of the cases of the upper tier of blocks in which the blocks do not touch one another, the front dowels have been omitted, but in some of these instances the back dowels are in place. As the lower tier of blocks is considerably below low water the joints between the blocks of this tier could not be examined, but the absence of any dowels in these blocks which are below the waves is of less importance.

The value of the dowels is not in affording strength to the adjoining blocks by connecting them together, as the weight of the blocks is sufficient to make them stable without any union. The dowels are chiefly useful in checking the rapid influx or reflux of the sea which might wash out some of the hearting or might scour the sand from below the blocks. They are also of value in preventing violent shocks being communicated to the hearting in the interior of the pier from waves acting directly on water or air in the joints, or in any interstices in the hearting.

I think at Ballycotton none of these effects are in progress, as I found that the effect of a sea on the hearting was insignificant. A wave four or five feet high produced a variation of less than two inches in a hole dug 14 feet deep in the hearting, and this effect would be still further reduced in the undisturbed hearting. All that appears to me necessary in connection with the subject of the dowels is, that in the instances where they have been omitted, bags of concrete should be inserted between the blocks, which can easily be effected in calm weather.

(3.) The third point, viz., that the filling between the walls was of inferior quality, was more insisted upon by the Rev. M. P. Norris than by the county surveyor, but the latter also stated that it was one of his objections to the pier. There is no doubt that the hearting and paving above it have subsided to the extent of from two to six inches in some of the bays between the cross walls near the pier-head, and channels have been cut through the coping to enable surface-water to drain away.

The nature of the material of the hearting of a pier of this description is an important matter. It should be all of material which is incompressible and unaffected by water, and nothing is better than rubble stone. The stones should be of various sizes, with a small quantity of fine gravel, and the whole should be so mixed together that when consolidated few or no interstices would remain.

The clause of the contract specification referring to hearting is as follows:—

“The filling of the pier shall consist of rubble stones of various sizes, no earth or sand being used. The rubble stones are to be hand-set on their flattest beds for a width of six feet behind all walls.”

As mentioned above, I should prefer a small proportion of fine gravel, or even coarse sand, but it was stated by several witnesses who were employed as carters in conveying the rubble for the hearting from the quarry, that

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large quantities of dirt as small as dust, which would when wetted become mud, were put into the hearting, and that stones were put on the top of the carts to deceive the Clerk of the Works. Another witness estimated that as much as half the hearting was earth of this description. The statement that there was a considerable admixture of soft earth was endorsed by Captain Longfield, who subscribed a considerable sum to the cost of the pier, and by the Rev. M. P. Norris. On the other hand, the contractor and some of the representatives of the Board of Works stated that the hearting was in strict accordance with the terms of the contract.

The points of interest are :—First, whether there is a sufficient admixture of large and small stones; secondly, whether there was any considerable quantity of earthy matter which might become mud, and, sinking to the bottom of the hearting, be washed out by the sea.

The conflict of evidence being so pronounced as to the nature of the hearting, I directed that three holes should be sunk through the pavement of the pier as deep as they could be carried, and that the position of the holes should be selected by the Rev. M. P. Norris. These holes were made under the supervision of my assistant, Mr. Gifford, of Mr. Keating, and of the Rev. M. P. Norris, and the position of the holes, which are numbered 1, 2, 3, is shown on the plan (Fig. 1). The Board of Works subsequently desired that three more holes should be dug, and these are numbered 4, 5, 6, on the plan. The six holes having been sunk, the nature of the hearting was carefully examined by my assistant, and samples were sent to me for my own examination.

As respects the size of the hearting, it was found that the proportion which passed through a sieve of an inch mesh was as follows :—

No. 1	-	-	-	-	$2\frac{1}{2}$	parts out of 9.
" 2	-	-	-	-	$2\frac{1}{2}$	" " 9.
" 3	-	-	-	-	1	" " 9.
" 4	-	-	-	-	1	" " 9.
" 5	-	-	-	-	$1\frac{1}{2}$	" " 9.
" 6	-	-	-	-	$5\frac{1}{2}$	" " 9.

Samples of the hearting were further examined by washing, and it was found that from 6 per cent. to 12 per cent. of the whole could be by persistent washing be removed, and must have originally consisted of earthy matter.

The hearting was, however, in all cases compact, and there was no sign of any space existing beneath the paving, nor of the paving having subsided at the holes Nos. 1, 2, and 3, situated in the portion of the pier which was executed early in the proceedings, and is founded on rock. Adjoining the holes Nos. 4, 5, and 6, where the pier is resting on sand, the settlement of the paving is considerable. I believe this to be due partly to subsidence or consolidation of the hearting itself and partly to compression of the sand on which it was deposited; I was informed that the hearting near this end of the pier was deposited much more rapidly than that near the shore, and had less time to become consolidated before the paving was laid.

The earth which has been found in the hearting ought certainly not to have been allowed by the Clerk of the Works to be used in the work, and there is a larger amount of small material at the holes 1, 2, and 6, than ought to have been permitted. There are, however, no signs of any washing away of any of the earthy matter, and though its presence and the undue amount of small material in some places have caused some at least of the sinking and cracking of the pavement referred to in objection (6), I am of opinion that although these defects are unsightly, no damage has been caused to the stability of the pier by the defects in the hearting.

On examination, it was found that there was no evidence of there being any space between the top of the hearting and the bottom of the paving.

With regard generally to the cracks in the paving, I may say that if ordinary pitching had been used the cracks would not have been apparent, and that it would be almost impossible to lay a continuous bed of concrete with flat bedded paving upon it (such as exists at Ballycotton), resting on hearting deposited on wet sand, without some cracks becoming visible on the surface of the paving. The paving can be easily lifted where it has subsided, and at small cost.

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In digging the holes 4, 5, 6, it was found that the concrete under the paving adjoining those holes had been made with cement of inferior quality which had not set, and consequently the concrete was little better than loose gravel. There was evidence also of carelessness in mixing the concrete. As the concrete is merely a bed for the paving the defects in it do not affect the stability of the pier, but it should be replaced with good concrete when the paving is relaid.

The quantity of bad concrete under the paving is apparently not large, but the amount has not been exactly ascertained. At the other holes (1, 2, 3) the concrete beneath the paving was perfectly sound and very hard.

(4.) The fourth objection raised is that the depth of water in the harbour on the site of the old pier and landward of it, is insufficient. This question does not enter into the subject of the stability of the works in which the Grand Jury, who have to maintain the works, are chiefly interested, and it is outside the terms of your Lordships' reference to me. It appeared, however, that much stress was laid upon the matter of depth by the fishermen and local witnesses, and Mr. Jackson considered it would be best that I should report to your Lordships thereon.

When the new pier was first undertaken it was intended that the caud of the old pier (shown in dotted lines on Figs. 1 and 2) which projected into the new harbour should be left standing so that small craft and boats might lie in shelter behind it. Opinions differed as to the advisability of leaving the projecting portion of the old pier standing, and accordingly a clause was inserted in the contract as follows :—

" Note.—If ordered to do so in writing the contractor will have to  
 " take down the existing pier from the line C D to the pier-head.  
 " The walls and filling are to be removed to a depth of one foot below  
 " the present level of harbour bed adjacent."

Eventually the bulk of local opinion was in favour of removal, and the Board of Works gave orders to the contractor under the terms of the above clause to remove the old pier to depths shown in a drawing on which the new depths were figured.

The questions have been raised ; (1) whether the contractor has complied with the terms of his contract in view of the depths which now exist on the site ; and (2), whether if this be so, the present condition of the harbour at the site of the old pier is satisfactory.

It is to be observed that the depths indicated on the drawing furnished to the contractor appear to be less than one foot below the level of the harbour bed adjacent, but I conceive that the specific orders so given relieve the contractor from liability if he has worked to them.

I have found much difficulty in coming to any conclusion as to what was the depth of water adjoining the old pier, owing to the contradictory nature of the oral evidence given to me on the subject, and from the fact that the plans which exist of the old harbour are on a small scale with but few soundings.

Forming the best judgment I can on the data at my disposal, I think that the depth of water at the end of the old pier below low water of ordinary spring tides was about five feet, but that this depth was very limited in area on the inside of the pier, and that the water shoaled gradually from the old pier-head, towards the low water-line, which is shown on the contract plans, and is reproduced on Fig. 1.

A careful series of soundings was taken by my assistant in October last, and I have compared them with the soundings taken by the Engineer of the Board of Works on 28th February 1888. These two sets of soundings agree substantially together, and indicate that the line of low water is now slightly seaward of the line shown on the contract plan. This favours the view advanced by the local witnesses, and sustained by the clerk of the works, that some of the *débris* of the old pier was spread on the bed of the old harbour.

I think, however, that the amount of *débris* so deposited landward of the old pier must have been but small as the maximum advancement of the low

water-line appears not to exceed six or seven yards on a very flat foreshore, dying off within 20 yards along the shore in each direction to the old low water-line.

In order to consider the question of the actual site of the old pier, which is the more important question, I have plotted sections of the bottom of the harbour on various lines, of which the lines A, B, C, D, are approximately parallel to the general direction of the new pier and cross the site of the old pier, while the line E F is to the west of it. I have also plotted sections, G H, I J, K L, which cross the site of the old pier at right angles, *see* Figs. 4 and 5.

It will be seen that on the lines A, B, C, D, the ground shoals much more rapidly than on the line E F, and that a vessel running into the harbour on the two first-mentioned lines would be brought up very suddenly by grounding on the site of the old pier, whereas if she were on the line E F, she would have more room. If again the sections G H, I J, K L, are considered across which a vessel lying in the harbour may readily be supposed to be moored it will be seen that the site of the old pier undoubtedly projects upwards beyond the general level of the ground, so that a vessel may ground on the site in a dangerous way.

I think that from the point of view of general convenience of the harbour the danger of boats grounding on the lines G H, I J, K L, is appreciable, and that the rapid shoaling of the water at the site of the old pier on the lines A B and C D, as compared with the lines E F, is decidedly objectionable, and likely to cause damage to boats running into the harbour.

My opinion, therefore is, that on the above grounds there is ground for complaint of imperfection in the harbour.

The drawing issued by the Board of Works in order to specify the depths to which the pier was to be removed was made on the principle of taking points on the surface of the shore on each side of the pier and uniting them by a straight line, and if these instructions had been executed there would have been less ground for complaint, though the levels in question would not have given a depth in all cases of "one foot below the ground adjacent to the pier."

The soundings, however, which have been taken by Mr. Gifford last October, and by Mr. Keating in February last, show that the depths shown on the drawing issued by the Board of Works do not exist, and that the site of the old pier is from two to two and a-half feet higher than was ordered.

It is, I believe, contended by the contractor, and acquiesced in by the Board of Works, that although the depths of water on the site of the old pier are less than what they would have been if the drawing of the Board of Works had been carried out, the want of depth is due to the site of the pier being rocky and to the interior of the pier being higher than the bottom of the walls on either side; and it is held that the contractor who was not bound to do more than remove *débris* has fulfilled the conditions of his contract though he did not work to the engineer's drawing. It appears to me that this contention is correct provided it be a fact that no *débris* remains on the site of the pier.

A drawing of the old pier in 1846 has a cross section of the pier to an enlarged scale, and this shows the site as level without any rocks projecting upwards.

When I was at Ballycotton the engineer to the Board pointed out to me a portion of the site which had the appearance of being rock *in situ*, but it was contended by the local fishermen that this was not the case. The time during which the site is left by the tide was so short, and the surface is so much hidden by weed and a thin coating of mud, that it was impossible for me to come to a distinct conclusion as to how much, if any, of the site consists of the *débris* of the pier and how much may be rock *in situ*.

However this may be I am of opinion that the present site of the old pier is higher than it ought to be, having regard to the convenience of the harbour.

I have shown by red lines (on the sections, Figs. 4 and 5) the intended level of the ground as ordered by the Board of Works, the black lines indicating the existing levels. It will be seen that it would be desirable to deepen



deepen the site of the old pier by from three to four feet, and I have shown by red dotted lines the levels which should, in my opinion, be adopted.

It is right to observe that the Board of Works have out of moneys saved from the vote considerably improved the harbour by the removal of various dangerous rocks which projected upwards beyond the general surface of the bottom, several of which were seaward of the old pier, and that they have also flattened and improved the strand, generally, for boats, none of which matters were included in the contract.

On the 6th to 10th of last month there was a remarkably severe gale in the Channel, and some alarming statements were made of the effect of the gale on Ballycotton Pier. I was, in consequence, requested by your Lordships to send my assistant to make a further examination of the pier. This was done, and the levels and measurements previously taken were checked. The result is that no subsidence, or alterations of levels or measurements are observable. Heavy seas had broken over the pier, and the sand or gravel which had accumulated from time to time in the cracks in the paving had been washed out of the cracks which were thus more apparent than previously, but Mr. Gifford could discover no new cracks or alterations except in the following instances: Some movement of the cement concrete adjoining the crack on the sea face of the pier-head (to which I have referred in detail above) had taken place, and portions of the face had become detached. The amount of concrete which has been removed at this spot since my visit in October is about five feet long, one and a-half feet wide, and 10 inches deep. Whatever may be the precise cause of this detachment of the face of the wall the occurrence confirms me in my recommendation that the pier-head should be strengthened, as I have suggested.

Another crack was specially pointed out in the parapet wall as due to the gale. At this spot, one of the boards in which the concrete was moulded *in situ* was left in its place, in order to make a straight joint and so avoid an irregular crack from shrinkage. The crack had been previously observed, and I do not consider it of any importance as affecting the stability of the pier.

The second examination of the pier shows that the gale, which seems to have been very heavy (the wind being registered at Kingstown at a velocity of 48 miles an hour), did practically no damage to the pier generally, and that the only cause for any anxiety is the extreme pier-head.

I venture to hope that if the works which I have recommended, or some similar mode of strengthening the pier-head, be executed, the objections of the Grand Jury to taking over the maintenance of the pier would be at an end, and I think also that if the site of the old pier be deepened as suggested, the harbour would be in much the same condition as to depth, as was contemplated by the terms of the contract, and the complaints of the fishermen would be fairly met.

In conclusion, I may remark that (subject to the matters to which I have drawn attention as requiring amendment) I consider Ballycotton Pier to have been well designed, both as to position and in detail, and that as far as I can judge, the workmanship appears to be generally good and substantial. The harbour must be of great value to the fishing craft frequenting the coast.

I have, &c.  
(signed) J. Wolfe Barry.

BALLYCOTTIN PIER.

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COPY of REPORT on the PIER at BALLYCOTTIN,  
County Cork, by Mr. John Wolfe Barry, M.I.E.C.,  
dated the 21st December 1888.

(Mr. Jackson.)

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# BALLYCOTTIN PIER.

Fig. 1.

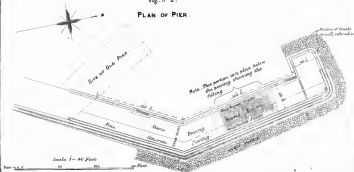
GENERAL PLAN.



**BALLYCOTTIN PIER.**

W. J. J.

## PLAN OF RESEARCH



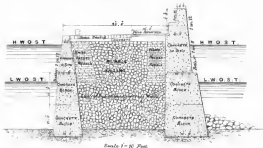
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# BALLYCOTTIN PIER.

Fig. No. 3.

TRANSVERSE SECTION.



# BALLYCOTTIN PIER.

Fig. No. 4.

SECTIONS (SEE GENERAL PLAN.)

## SECTION ON LINE A B.



## SECTION ON LINE C D.



## SECTION ON LINE E F.



Horizontal Scale 1" = 50 Feet.

L.W.O.S.T. 0 10 20 30 40 50 Feet

Vertical Scale 1" = 10 Feet.

0 1 2 3 4 5 6 7 8 9 10 Feet